

PATENT COOPERATION TREATY  
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**NOTIFICATION OF THE RECORDING  
OF A CHANGE**

(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

**Date of mailing (day/month/year)**

25 January 2002 (25.01.02)

**Applicant's or agent's file reference**

22210 PC 1

**International application No.**

PCT/DK00/00331

RECEIVED  
WIPO  
JUN 21 2002  
INTERNATIONAL  
SEARCH CENTER - WIPO

To:

PLOUGMANN & VINGTOFT A/S  
Sankt Annæ Plads 11  
P.O. Box 3007  
DK-1021 Copenhagen K  
DANEMARK

**IMPORTANT NOTIFICATION**

**International filing date (day/month/year)**

21 June 2000 (21.06.00)

**1. The following indications appeared on record concerning:**

the applicant     the inventor     the agent     the common representative

**Name and Address**

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**2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:**

the person     the name     the address     the nationality     the residence

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PLOUGMANN & VINGTOFT A/S  
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**State of Residence**

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**3. Further observations, if necessary:**

**4. A copy of this notification has been sent to:**

<input checked="" type="checkbox"/> the receiving Office	<input type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input checked="" type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

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Authorized officer

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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>22210 PC 1</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/DK 00/00331</b>	International filing date ( <i>day/month/year</i> ) <b>21/06/2000</b>	(Earliest) Priority Date ( <i>day/month/year</i> ) <b>24/06/1999</b>
Applicant <b>CARNEHAMMAR, Lars Bertil</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the language, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

- the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).
- b. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of the sequence listing :
- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2.  Certain claims were found unsearchable (See Box I).

3.  Unity of Invention is lacking (see Box II).

4. With regard to the title,

- the text is approved as submitted by the applicant.
- the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- the text is approved as submitted by the applicant.
- the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the drawings to be published with the abstract is Figure No. \_\_\_\_\_

- as suggested by the applicant.
- because the applicant failed to suggest a figure.
- because this figure better characterizes the invention.

None of the figures.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/DK 00/00331

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 B60C19/00 G01M1/32

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B60C G01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 431 726 A (RONLAN ALVIN) 11 July 1995 (1995-07-11) cited in the application claims ---	1,4
A	GB 1 209 696 A (SUNLAND REFINING CORP.) 21 October 1970 (1970-10-21) page 3, left-hand column, line 51 -page 4, line 53; claims ---	1,12
A	US 5 083 596 A (KATO HIROSHI ET AL) 28 January 1992 (1992-01-28) column 4, line 64 -column 5, line 44; table ---	1-7 -/-



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

6 September 2000

13/09/2000

Name and mailing address of the ISA

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Authorized officer

Baradat, J-L

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/DK 00/00331

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A ..	US 5 073 217 A (FOGAL ROBERT D) 17 December 1991 (1991-12-17) column 6, line 30 -column 9, line 2; claims -----	1,6,7,12
A	GB 2 074 955 A (UNIROYAL ENGLEBERT GMBH) 11 November 1981 (1981-11-11) -----	

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/DK 00/00331

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5431726	A	11-07-1995	SE 500179 C AT 142684 T BR 9104740 A DE 69122119 D DE 69122119 T DK 557365 T EP 0557365 A ES 2091950 T GR 3021967 T SE 9003577 A WO 9208775 A SG 52524 A US 5540767 A	02-05-1994 15-09-1996 23-06-1992 17-10-1996 30-01-1997 30-09-1996 01-09-1993 16-11-1996 31-03-1997 10-05-1992 29-05-1992 28-09-1998 30-07-1996
GB 1209696	A	21-10-1970	AU 422573 B AU 3925568 A BE 716908 A DE 1750970 A FR 1570207 A NL 6808749 A US 3463551 A	22-03-1972 08-01-1970 20-12-1968 25-03-1971 06-06-1969 23-12-1969 26-08-1969
US 5083596	A	28-01-1992	NONE	
US 5073217	A	17-12-1991	AT 142567 T AU 660159 B AU 9019491 A BR 9106930 A CA 2094260 A DE 69122129 D DE 69122129 T DK 591216 T EP 0591216 A JP 6510716 T NO 303002 B WO 9206857 A	15-09-1996 15-06-1995 20-05-1992 20-07-1993 18-04-1992 17-10-1996 03-04-1997 24-02-1997 13-04-1994 01-12-1994 18-05-1998 30-04-1992
GB 2074955	A	11-11-1981	DE 3014213 A FR 2480201 A	15-10-1981 16-10-1981

## PATENT COOPERATION TREATY

REC'D 28 SEP 2001

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| 4

Applicant's or agent's file reference 22210 PC 1	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/DK00/00331	International filing date (day/month/year) 21/06/2000	Priority date (day/month/year) 24/06/1999	
International Patent Classification (IPC) or national classification and IPC B60C19/00			
<p><b>Applicant</b> CARNEHAMMAR, Lars Bertil et al.</p>			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I    <input checked="" type="checkbox"/> Basis of the report</li> <li>II    <input type="checkbox"/> Priority</li> <li>III    <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV    <input type="checkbox"/> Lack of unity of invention</li> <li>V    <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI    <input type="checkbox"/> Certain documents cited</li> <li>VII    <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII    <input type="checkbox"/> Certain observations on the international application</li> </ul>			

Date of submission of the demand 19/01/2001	Date of completion of this report 26.09.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Vessière, P  Telephone No. +49 89 2399 7279



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK00/00331

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):  
**Description, pages:**

1-9                   as originally filed

**Claims, No.:**

1-12                  as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- the description,        pages:
- the claims,              Nos.:
- the drawings,            sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/DK00/00331

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims 1-12
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-12
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-12
	No:	Claims

2. Citations and explanations  
**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/DK00/00331

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

- D1: US-A-5 431 726 (1995-07-11) cited in the application,  
D2: US-A-5 083 596 (1992-01-28).

1. The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and insofar as this claim can be understood (see Section VIII), this document discloses (cf. D1 claim 1) a tyre balancing composition, which comprises a visco-plastic gel.  
The subject-matter of claim 1 differs from the known balancing composition in that the balancing composition further comprises solid bodies having an average smallest dimension in the range of 0.5-5 mm.

The subject-matter of claim 1 is therefore novel (Article 33(2) PCT).

2. The problem to be solved by the present invention may therefore be regarded as an improvement of the balancing efficiency of the composition.

The solution proposed in claim 1 of the present application seems to involve an inventive step (Article 33(3) PCT) because there is no suggestion in the available prior art documents, to add such solid bodies to a visco-plastic gel so as to improve the balancing effect.

The "solid bodies" described in document D2 (cf. col.4, li.38-47; "additive of greater specific gravity...") could not be considered as providing the same effect, because the purpose of the fluid in which the particles are dispersed is not the wheel balancing, but the "fly wheel effect" or increase of inertia.

- 3.1 Claims 2 - 8 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
- 3.2 Independent claim 9, and its dependent claims 10 - 11, defining a kit having the

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/DK00/00331

same components that the tyre balancing gel of claim 1 is novel and inventive for the same reasons.

3.3 The independent method claim 12 is novel and inventive for the same reasons.

**Re Item VII**

**Certain defects in the international application**

1. Independent claim 1 is not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1: a tyre balancing composition comprising a visco-plastic gel) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

**(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)**

**(19) World Intellectual Property Organization  
International Bureau**



(43) International Publication Date  
4 January 2001 (04.01.2001)

PCT

(10) International Publication Number  
**WO 01/00430 A1**

(51) International Patent Classification<sup>7</sup>: B60C 19/00, G01M 1/32

(21) International Application Number: PCT/DK00/00331

(22) International Filing Date: 21 June 2000 (21.06.2000)

(25) Filing Language: English

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(30) Priority Data:  
99112199.7 24 June 1999 (24.06.1999) EP

(71) Applicant (for all designated States except US): CARNE-HAMMAR, Lars, Bertil [SE/GB]; 52 Allestree Road, London SW6 6AE (GB).

(72) Inventor; and

(75) Inventor/Applicant (for US only): RONLAN, Alvin [DK/US]; 3414 Norfolk Street, Hillsboro Shores, FL 33062 (US).

(74) Agent: PLOUGMANN, VINGTOFT & PARTNERS A/S; Sankt Annæ Plads 11, P.O. Box 3007, DK-1021 Copenhagen K (DK).

(81) Designated States (national): AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published:**  
*With international search report.*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

*With international search report.*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**(54) Title: TYRE BALANCING COMPOSITIONS**

WO 01/00430 A1

(57) **Abstract:** The invention relates to tyre balancing compositions having improved balancing properties comprising a visco-plastic gel and solid bodies having an average smallest dimension in the range of 0.5-5 mm; preferably 1-4 mm, more preferably around 3 mm. When applied in a layer to the inside of a motor vehicle tyre, the compositions act by allowing the solid bodies move through the gel and to concentrate in areas to counteract imbalances. The solid bodies preferably have an average ratio  $\alpha$  between their smallest and their largest dimension of  $\alpha \leq 2$ , more preferably  $\alpha \leq 1.5$ , especially around 1. The visco-plastic gel preferably has a storage modulus ( $G'$ ) between 1000 Pa and 25000 Pa at 22 °C, a loss modulus ( $G''$ ) smaller than the storage modulus, and a critical yield stress above 3 Pa at 22 °C. The bodies may be shaped as prolate or oblate ellipsoids, cylinders, rectangular parallelopipeds, or spheres, or mixtures of such bodies; they may have an apparent specific gravity in the range of 500-3000 kg/m<sup>3</sup>, preferably 600-2000 kg/m<sup>3</sup>, in particular 700-1000 kg/m<sup>3</sup>, especially 800-900 kg/m<sup>3</sup>; they may be made from polyolefins, polystyrene, polyvinyl chloride, polyamide, rubber or glass. The weight ratio between the solid bodies and the gel is from 10:1 to 1:10, preferably from 5:1 to 1:5, in particular from 2:1 to 3:1, such as from 1:1 to 1:2. The invention further concerns a tyre balancing kit and a method for balancing automobile wheel assemblies.

**TYRE BALANCING COMPOSITIONS****FIELD OF THE INVENTION**

- 5 The present invention relates to tyre balancing compositions for use in eliminating/reducing vibrations in motor vehicle wheel assemblies related to tyre and rim imperfections, as well as to the use of such compositions.

**BACKGROUND OF THE INVENTION.**

10

Vibrations in rolling wheel assemblies (tyre + rim) are caused by several, different types of tyre imperfections, the most important being:

- Non-homogeneous mass distribution
- Stiffness variations

15

- Geometric variations
- Radial and lateral run outs
- Eccentricity

Similarly, imperfections in the rim will also induce vibrations.

20

The at present most common method for elimination of wheel assembly derived vibrations is still the attachment of lead weights to the tyre rim. However, quite apart from giving rise to a diffuse lead pollution in the environment through the weights falling off, this method can only compensate (and even at best only partially) for vibrations caused by non-

25 homogeneous mass distribution in the wheel assembly, and since the other imperfections mentioned above are just as important sources of vibrations, lead weight balancing is not a satisfactory method for balancing of modern quality tyres.

European Patent No. 0557365 describes a different approach to reduction of vibrations

30 induced by wheel assembly imperfections, comprising introduction of a visco-plastic gel into the tyre cavity. The principle behind the action of such gels is that they are able to flow under the stresses induced by vibrations and therefore spontaneously distribute themselves in a rolling tyre in such a way that the vibrations are reduced irrespective of what type of imperfections they are induced by. The efficiency of these balancing gels as  
35 compared to lead weight balancing can be demonstrated experimentally by measuring

vertical accelerations on the spring leg of a front axle with its wheels running under load against a rotating drum. Typical results have shown that lead weight balancing actually increases vertical accelerations which clearly demonstrates that other sources of vibrations than non-homogeneous mass distribution are more important in this case.

- 5 However, such balancing gels cannot completely eliminate vibrations caused by wheel assembly imperfections, because the centrifugal stress induced in a balancing gel by localised thickening (which occurs to diminish vibrations) will eventually be as strong as the residual vibrational forces caused by the imperfections, and therefore an equilibrium is established where a certain level of vertical accelerations will remain.

10

Also, a drawback with gel compositions in general is that a fairly large amount of gel must be employed per tyre since a gel is not able to form localized "lumps" in the manner of a lead weight but must instead form a film layer with a continuously and gradually changing depth in order to provide the required balancing.

15

#### SUMMARY OF THE INVENTION.

The object of the present invention is to eliminate or substantially reduce the above

- 20 mentioned remaining level of vertical accelerations as well as provide a significant reduction of the amount of composition needed per tyre. It has now been found that by incorporating or imbedding into the gel layer a certain amount of solid masses or bodies of a certain size, said size being at least sufficiently large to enable the bodies to move through the gel layer under the influence of acceleration forces induced by imbalances,
- 25 but not so large so as to themselves begin to induce vibrations, greatly enhances and expands the ability of the composition to reduce vibration and to balance wheel assemblies.

The invention therefore concerns a tyre balancing composition which comprises on the

- 30 one hand a visco-plastic gel and on the other hand solid bodies having an average smallest dimension in the range of 0.5-5 mm.

In the present context, the term "solid" as applied to the bodies is intended to mean

particles having a continuous and fairly smooth surface, but not necessarily having no

- 35 voids or cavities. Thus, a solid body within the meaning of the present invention may be

hollow or have internal porosities, although a truly solid body, i.e. one having a continuous material phase all through and no cavities or porosities, is preferred.

- The invention also relates to a tyre balancing composition kit, a balancing composition  
5 according to the invention contained in a wheel assembly, as well as a method for  
balancing motor vehicle wheel assemblies.

The gels in which the solid bodies are present or imbedded to form the compositions of  
the invention will in the following be known as DFC (Dynamic Force Compensation) gels.

10

#### DETAILED DESCRIPTION OF THE INVENTION

The solid bodies imbedded in the gels to act as moving masses may be any type of solid  
15 bodies of the specified dimensions which are able to be dispersed discretely in a visco-  
plastic gel. In a preferred embodiment, the bodies have an average ratio  $\alpha$  between their  
smallest and their largest dimension of  $\alpha \leq 2$  since particles with larger such aspect ratios  
tend only to move with ease in the longitudinal direction,  $\alpha$  preferably being  $\leq 1.5$ , in  
particular around 1.

20

Due to the increasing importance with decreasing particle size of molecular interactions  
(hydrogen bonding, van der Waals forces, electrostatic interactions, etc.) between the solid  
masses and the visco-plastic gel in relation to the vibrational and centrifugal forces acting  
on the masses, masses with a average diameter below 0.1 mm do not seem to contribute  
25 to the balancing efficiency of the gel-particle composition. Consequently, the smallest  
dimension of the bodies is, as stated above, in the range 0.5-5 mm. In a preferred  
embodiment, the average smallest dimension of the bodies is in the range of 1-4 mm, in  
particular around 3 mm.

30 Suitable visco-plastic gels that will enable imbedded masses move in order to  
compensate vibrational forces to a smaller or larger degree can be defined in rheological  
(as measured with a Stress Tech Rheometer from Rheologica AB, Lund, Sweden) by the  
following characteristics:

35 Storage Modulus3 (G'): Between 1000 Pa and 25000 Pa at 22°C

Loss Modulus3 (G''): Smaller than the Storage Modulus

Critical Yield Stress : Exceeding 3 Pa at 22°C.

In a preferred embodiment, the Storage Modulus is around 9000 Pa at 22°C. The Critical

5 Yield Stress is preferably around 30 Pa at 22°C.

In order to interact in a suitable manner with the tyre and the imbedded solid bodies, the composition of the invention should preferably also exhibit suitable adhesive properties ("stickiness") with respect to the tyre and the bodies. Thus, the adhesion between tyre

10 inner lining and the visco-plastic gels as well as the adhesion between imbedded masses and the visco-plastic gels may be evaluated in the following two step practical test:

Step 1:

A two mm thick, 100x100 mm square of the visco-plastic gel to be tested is applied to the

15 middle of a sheet (200x200 mm) of chloro-butyl rubber glued onto a stiff support (metal plate) as well as to the middle of a similar sheet of butyl rubber. The two sheets are raised into a vertical position and left standing for 24 hours at 22°C and 65% R.H. If the displacement of the upper rim of the gel-square is less than 3 mm on both test surfaces, the adhesion of the gel component to tyre inner linings is deemed satisfactory.

20

Step 2:

A two mm thick, 100x100 mm square of a visco-plastic gel that conforms to the

requirements of Step 1 of this test is applied to the middle of a sheet (200x200 mm) of chloro-butyl rubber glued onto a stiff support (metal plate), and 10 HD polyethylene disk-

25 shaped pellets (specific weight 0.9, disk average diameter: 4.5 mm, disk average height 3 mm) are inserted randomly into the gel. The sheet is raised into a vertical position and left standing for 24 hours at 22°C and 65% R.H. If the average displacement of the pellets is less than 2 mm, the adhesion of the gel component to solid masses is deemed satisfactory.

30 Visco-plastic gels that conform to both step both Step 1 and Step 2 of this test are considered suitable with respect to adhesive properties.

Apart from the rheological and adhesive criteria defined above, visco plastic gels suitable for use in this invention should preferably also satisfy certain other physical and chemical

criteria that will ensure optimum function under the operating conditions and environment of this particular application, such as:

- compatibility with tyre inner liners,
- proper response and displacement under the action of combined centrifugal and
- 5 vibrational shear stresses,
- constancy of response over a broad temperature range,
- stability of material properties and response over many years in use,
- chemical inertia of the gel components vis a vis tyre inner liner rubber,
- stability of the gel composition and properties under high g-stress and shear stresses,
- 10 • little change in material properties and behaviour upon ageing in normal operating conditions.

The visco-plastic gels, in which the solid bodies are imbedded to form the balancing compositions of the invention, may be of any chemical composition which provides the

15 visco-plastic properties required, preferably as defined above as well as with the other physical and chemical properties enumerated above. Such visco-plastic gels will typically be composed from on the one hand one or more organic base oils having a suitably low viscosity index and on the other hand a gel former. Non-limiting examples of base oils are mineral oil, polyol esters of fatty acids derived from synthetic or naturally occurring polyols  
20 and fatty acids, synthetic hydrocarbon oils such as polypropylene oils, poly-alpha-olefins, polybutenes, polyglycols such as liquid polyethylene glycol or liquid polypropylene glycol, or ethylene oxide/propylene oxide copolymers, as well as mixtures thereof. Non-limiting examples of gel formers are colloidal silicas, polyacrylic acids, bentonite clay and metal soaps.

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One suitable type of gels are those described in the above mentioned European Patent 0557365 (or its US counterpart US patent 5,431,726 which is hereby incorporated by reference).

30 The solid bodies may suitably be shaped as prolate or oblate ellipsoids, cylinders, rectangular parallelepipeds, or spheres, or mixtures of such bodies. They may be prepared through any method known in the art such as emulsion polymerisation of polymers or cutting rectangular or circular cross-section extrudates into suitable lengths.

In order that the solid bodies do not interact unduly with the inside of the tyre when under the influence of centrifugal forces, it is preferred that the apparent specific gravity of the solid bodies is in the range of 500-3000 kg/m<sup>3</sup>, more preferably 600-2000 kg/m<sup>3</sup>, in particular 700-1000 kg/m<sup>3</sup>, especially 800-900 kg/m<sup>3</sup>. The term "apparent specific gravity"

- 5 as applied to the solid bodies refers to the ratio between the weight of each individual solid body and the volume enclosed by the outer, continuous surface. Thus, it will be clear that if the bodies are hollow or otherwise include voids or are porous, the apparent specific gravity may lower than the nominal specific gravity of the material from which the bodies are made.

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The solid bodies should preferably be made from a material which does not interact unsuitably with the visco-plastic gel. Non-limiting examples of suitable materials for the solid bodies are various polymers such as polyolefins, e.g. polyethylene (either high or low density) or polypropylene; polystyrene; polyvinyl chloride; polyamides, e.g nylons; 15 rubbers such as butyl rubber or latex; or glass.

The content of solid bodies in the composition of the invention may vary within fairly wide limits since the purpose of the bodies is to able to move in the gel layer in order to establish zones with a high concentration of solid bodies to act as balancing elements.

- 20 The weight ratio between the solid bodies and the gel is preferably from 10:1 to 1:10, more preferably from 5:1 to 1:5, in particular from 2:1 to 3:1, such as from 1:1 to 1:2.

It will be evident that in order to work the invention, imbedding the solid bodies in the visco-plastic gel to form the composition of the invention need not take place outside the 25 tyre. Thus, when applying the teaching of the present invention, it will also possible to instead first distribute a suitable amount of a visco-plastic gel on the inside of a tyre and subsequently distribute a suitable amount of solid bodies on the gel layer, thereby forming a composition of the invention.

- 30 Consequently, the invention further concerns a tyre balancing composition kit comprising
- i) a first container containing a visco-plastic gel, and
  - ii) a second container containing solid bodies having their average smallest dimension in the range of 0.5-5 mm.

The visco-plastic gel and the solid bodies, respectively, preferably are defined as and/or exhibit the properties and attributes listed above.

In a preferred embodiment of the balancing kit of the invention, the weight ratio between  
5 the amount of visco-plastic gel in the first container and the amount of solid bodies in the second container is from 10:1 to 1:10, preferably from 5:1 to 1:5, in particular from 2:1 to 3:1, such as from 1:1 to 1:2.

In a particularly preferred embodiment, and in order to eliminate or reduce any errors in  
10 applying them in the correct amounts, the amounts of the visco-plastic gel and the solid bodies in the first and second containers, respectively, of the balancing kit according to the invention are adapted to be applied to one single automobile tyre, whether a passenger automobile tyre, a truck tyre or the like. Such amounts will typically be from 50 to 400 g per tyre for passenger vehicle tyres, and 300-1000 g per tyre for truck tyres.

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Due to the above described possibility of not combining the visco-plastic gel and solid bodies until in the tyre, the present invention likewise further relates to a tyre balancing composition according to the invention as defined above contained within the air cavity of a motor vehicle tyre.

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Finally, the invention also relates to a method for balancing a motor vehicle wheel assembly, said method comprising the steps of

applying to the inner surface of the tyre

25           i) a tyre balancing composition as defined above, or  
              ii) the components of a tyre balancing kit as defined above;

mounting the tyre on a tyre rim to form a wheel assembly; and

30           mounting the wheel assembly on a motor vehicle and driving the vehicle for a distance sufficient to allow the balancing composition to balance the wheel assembly, or

35           mounting the wheel assembly in a device that allows the wheel assembly to be rotated under load conditions similar to those experienced during actual road

driving and at a speed where resonance occurs in the wheel assembly, and rotating the wheel for a time sufficient to allow the balancing composition to reduce vibrations to a stable minimum.

- 5 The amount of visco-plastic gel applied to the inside of the tyre should preferably be in the range of 0.01-1 grams per cm<sup>2</sup>, more preferably 0.02-0.5 grams, in particular 0.02-0.1 grams per cm<sup>2</sup>, of the inner lining surface of the tyre adjacent the part of the tyre that actually contacts the road (the tyre tread). The amount of solid masses in the tyre balancing kit of the invention applied to the inside of the tyre should preferably be
- 10 between 10 and 200 g for car tyres and between 50 and 500 g for truck tyres, more preferably between 10 and 100 g for car tyres and between 50 and 300 g for truck tyres, in particular 20-80 g and 80-150 g, respectively.

The invention is further illustrated by the following non-limiting examples.

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#### EXAMPLE 1

A DFC-gel (250 g) consisting of 1 weight part of HD polyethylene disks (specific weight 20 0.9, disk average diameter: 4.5 mm, disk average height 3 mm), and 2 weight parts of a visco-plastic gel according to European patent no. 0557365 and consisting of an ethylene oxide (EO)/propylene oxide(PO) copolymer (UCON 50-HB-5100 from Union Carbide, theoretical molecular weight equal to 4000) and fumed silica (Aerosil 202 from Degussa), was introduced into the cavity of a Michelin 175/65/R14 tyre. The tyre was mounted on a 25 car and driven until all vibrations disappeared. The wheel assembly was dismounted from the car, and measurement in a spin-balancing machine showed only insignificant residual weight imbalance. Inspection of the inner tyre wall showed an uneven distribution of the polyethylene pellets as would be expected if balancing is to take place.

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#### EXAMPLE 2

100 g of a visco-plastic gel according to European patent no. 0557365 and consisting of 35 an ethylene oxide/propylene oxide copolymer (L1 from Lyondell Chemical Worldwide, Inc., EO to PO ratio equal to 1:1 and theoretical molecular weight (Mw) equal to 6500)

(74.0%), castor oil No. 1 (18.5%) and fumed silica (Aerosil A300 from Degussa) (7.5%) was introduced into the cavity of a Michelin 175/65/R14 tyre and spread around the inner perimeter. HD polyethylene disks (specific weight 0.9, disk average diameter: 4.5 mm, disk average height 3 mm) were then sprinkled evenly on top of the gel layer. The tyre  
5 was mounted on a car and driven until all vibrations disappeared. The wheel assembly was dismounted from the car, and measurement in a spin-balancing machine showed only insignificant residual weight imbalance. Inspection of the inner tyre wall showed a distribution of the polyethylene pellets as would be expected if balancing is to take place.

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### EXAMPLE 3

250 g of a visco-plastic gel according to European patent no. 0557365 and consisting of 93% of a 4:1 mixture of two ethylene oxide/propylene oxide copolymers (L1 from Lyondell  
15 Chemical Worldwide, Inc., EO to PO ratio equal to 1:1 and theoretical molecular weight (Mw) equal to 6500 (4 parts), and L1-Diol from Lyondell Chemical Worldwide, Inc., EO to PO ratio equal to 1:1 and theoretical molecular weight (Mw) equal to 13000) (1 part)) and 7% of fumed silica (Cab-O-Sil TS720 from Cabot Corporation) was introduced into the cavity of a Michelin XH4 235/75/15 tyre and spread around the inner perimeter. LD  
20 polyethylene spheres (specific weight 0.85, sphere average diameter: 4 mm) were then sprinkled evenly on top the gel layer. The tyre was mounted on a sports utility vehicle and driven until all vibrations disappeared. The wheel assembly was dismounted from the vehicle, and measurement in a spin-balancing machine showed only insignificant residual weight imbalance. Inspection of the inner tyre wall showed a distribution of the  
25 polyethylene spheres as would be expected if balancing is to take place.

## CLAIMS

1. A tyre balancing composition, which comprises a visco-plastic gel and solid bodies having an average smallest dimension in the range of 0.5-5 mm.  
5
2. A tyre balancing composition according to claim 1, wherein the solid bodies have an average ratio  $\alpha$  between their smallest and their largest dimension of  $\alpha \leq 2$ , preferably  $\alpha \leq 1.5$ , especially around 1.
- 10 3. A tyre balancing composition according to claim 1 or 2, wherein the average smallest dimension of the solid bodies is in the range of 1-4 mm, preferably around 3 mm.
4. A tyre balancing composition according to any of claims 1-3, wherein the visco-plastic gel has a storage modulus ( $G'$ ) between 1000 Pa and 25000 Pa at 22°C, preferably  
15 around 9000 Pa at 22°C, a loss modulus ( $G''$ ) smaller than the storage modulus, and a critical yield stress above 3 Pa at 22°C, preferably around 30 Pa at 22°C.
5. A tyre balancing composition according to any of claims 1-4 wherein the solid bodies are shaped as prolate or oblate ellipsoids, cylinders, rectangular paralleipipeds, or  
20 spheres, or mixtures of such bodies.
6. A tyre balancing composition according to any of claims 1-5 wherein the apparent specific gravity of the solid bodies is in the range of 500-3000 kg/m<sup>3</sup>, preferably 600-2000 kg/m<sup>3</sup>, in particular 700-1000 kg/m<sup>3</sup>, especially 800-900 kg/m<sup>3</sup>.  
25
7. A tyre balancing composition according to any of claims 1-6 wherein the solid bodies are made from polyolefins, polystyrene, polyvinyl chloride, polyamide, rubber or glass.
8. A tyre balancing composition according to any of claims 1-7 wherein the weight ratio  
30 between the solid bodies and the gel is from 10:1 to 1:10, preferably from 5:1 to 1:5, in particular from 2:1 to 3:1, such as from 1:1 to 1:2.
9. A tyre balancing composition kit comprising  
35     i) a first container containing a visco-plastic gel, preferably a visco-plastic gel as defined in claim 4, and

ii) a second container containing solid bodies having their average smallest dimension in the range of 0.5-5 mm, preferably solid bodies as defined in any of claims 2, 3 or 5-7.

- 5 10. A tyre balancing composition kit according to claim 9 wherein the weight ratio between the amount of visco-plastic gel in the first container and the amount of solid bodies in the second container is from 10:1 to 1:10, preferably from 5:1 to 1:5, in particular from 2:1 to 3:1, such as from 1:1 to 1:2.
- 10 11. A tyre balancing composition according to any of claims 1-8 contained within the air cavity of a motor vehicle tyre.
12. A method for balancing a motor vehicle wheel assembly comprising applying to the inner surface of the tyre i) a tyre balancing composition according to any of claims 1-8, or  
15 ii) the components of a kit according to claim 9 or 10, mounting the tyre on a tyre rim to form a wheel assembly, and
- mounting the wheel assembly on a motor vehicle and driving the vehicle for a distance sufficient to allow the balancing composition to balance the wheel  
20 assembly, or
- mounting the wheel assembly in a device that allows the wheel assembly to be rotated under load conditions similar to those experienced during actual road driving and at a speed where resonance occurs in the wheel assembly, and  
25 rotating the wheel for a time sufficient to allow the balancing composition to reduce vibrations to a stable minimum.